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STUDY OF SOCIAL STRUCTURE IN FREE-RANGING HAMADRYAS BABOONS

ABSTRACT: *The description of the dynamics of social structure of the group of hamadryas baboons released to a subtropical forest in the vicinity of Sukhumi, Abkhazia (Georgia) is presented. During about 2 decades of observational period drastic changes in age/sex and social structure of the group took place. They have been expressed as a transformation of preliminary artificially formed group into a troop with characteristics typical for hamadryas baboons of Ethiopia. The thesis of succession of levels of organization in hamadryas baboons as a main mechanism of their development has been discussed.*

KEY WORDS: *Hamadryas baboons – Demography – Social structure*

INTRODUCTION

Study of primates in natural conditions made it possible to describe a wide spectrum of social structure of different primate species (Wrangham 1979, 1986). It is known that primates are characterized by two main types of social organization. One is so called multimale group structure and the other is one-male one (Byrne *et al.* 1987). Field studies of Kummer (1968, 1984), Abegglen (1984), Sigg *et al.* (1982), Biquand *et al.* (1992), as well as our own observations have shown that hamadryas baboons are characterized by a well defined one-male structure (Chalyan, Meishvili 1987, 1989, Chalyan *et al.* 1994). The main structural units of hamadryas baboons are one-male units or harems, which include one adult male and several females. Besides, big troops of hamadryas baboons include more complex structural formations – clans and groups.

One of the shortcomings of the recent investigations is the limited number of data concerning the development of social organization of primates, i.e., of the mechanisms of their development in the forming of different levels of organization, their connection and succession. Carrying out of such investigations takes many years of observations of rather big primate groups with definite identification of

individuals and knowledge about their kin relations. Here the results of investigations are presented in which the development of complex social organization in hamadryas baboons has been studied during long-term observations.

MATERIALS AND METHODS

The history of hamadryas baboons of Gumista Reserve

The history of monkey breeding in free ranging conditions in the forest around Suchumi in Abkhazia (Georgia) was started at the beginning of August 1974 when 76 hamadryas baboons from Ethiopia were supplied to a large glade on the bank of Eastern Gumista river (Lapin, Chalyan 1987). Choosing the territory for monkeys after a long search of the most suitable place according to a number of criteria was successful. There was a good road leading to the area, the river provided a good isolation and protection of animals from curious people, and a thick subtropical forest was going to be a good feeding reserve for African newcomers. Before being released to the forest the animals had been kept in the quarantine conditions in two group cages located on the lawn. The animals were not released

from the cages simultaneously, first were the juveniles and young females, and then were the adult sexually non-receptive females. Sexually receptive females and the two adult males were the last to be released. Keeping the animals together during the quarantine period and their release into the forest not simultaneously, but one by one, allowed to keep the integrity of artificially formed groups. Having been released in 1974, the hamadryas baboons served as a basis for the so-called First troop of Gumista Reserve. In the summer of 1979 a new group of hamadryas baboons was released to an area 2 km to the South which gave rise to the Second troop of Gumista reserve.

Since the baboons' release to the natural habitat the intervention of people to their life has been minimal. The monkeys eat predominantly natural products. Nevertheless they were daily provided also with pelleted food, which was scattered on concrete feeding places after a gong signal. Besides the every day inspection the animals were once a year caught out, investigated and weighted; all the newborns were tattooed.

Observation method

The observations in the Reserve were performed every day. Daily observations included registration of all the demographic changes in the troop, such as appearance of newborns, lack of animals during the observation, cases of death, as well as structural changes as for example

transition of females from a harem of one male into another one. Besides, individual registrations of the state of sexual skill of females were performed. Daily observations included also registrations of the order of appearance of monkeys on the lawn and the order of their leaving it.

Besides the daily registrations the observations were performed connected with study of ecology of hamadryas baboons in new conditions, as well as their social behaviour (Chalyan *et al.* 1987a, 1987b, Chalyan *et al.* 1991, Chalyan, Meishvili 2001). Standard methods were used for observation of a group and focal animals (Altmann 1974, Deriagina *et al.* 1984). Intensive observations were performed during the period between 1974 and 1992, after which they were interrupted due to military conflict between Georgia and Abkhazia. Military actions took place in close vicinity of the Gumista reserve territory.

Demographic processes in the troop

During the observation period the number of animals in the troop increased from 73 individuals at the beginning of 1975 to 323 in 1990 (Table 1). The specific rate of growth (Odum 1986, v. 2, p. 24) of the troop was varying between minimum 4% in 1977 and maximum 22% in 1981. Along with it, the mean specific rate of troop growth was 8%. Using Southwick's criterion for the assessment of a troop (Southwick 1980), according to which for keeping stability the population must include about 50% immature animals

TABLE 1. The dynamic of social structure of the First troop in Gumista Reserve.

Years	Number of animals	Number of harems	Mean number of females in harems	Socionomic relation	Number of bachelors
1975	73	2	16.5	1/ 17.5	0
1976	88	2	17.0	1/ 16.5	0
1977	104	2	17.0	1/ 18.5	0
1978	100	2	17.5	1/ 11.4	0
1979	102	4	9.8	1/ 6.3	0
1980	123	6	8.5	1/ 5.8	1
1981	145	7	7.6	1/ 4.2	2
1982	170	11	5.6	1/ 2.8	2
1983	189	12	5.3	1/ 2.4	7
1984	225	12	5.1	1/ 2.3	13
1985	240	14	4.9	1/ 1.9	15
1986	268	17	3.8	1/ 1.8	24
1987	279	23	3.1	1/ 1.7	25
1988	295	24	4.4	1/ 1.2	47
1989	297	21	4.5	1/ 1.2	49
1990	323	25	4.4	1/ 1.2	50

younger than 4, it was found out that the troop should be considered as a growing one actually in all the observation stages. The yearly level of young animals in the troop was about 51.2% with variations between 46.0 and 60.2% in different years.

The most evident were the variations in the number of mature males in the troop in different years. At first the males older than 4 years accounted only for 2.7% of the whole number of troop members, as soon as by 1978 their number increased to 8%. By 1990 the troop included 75 males older than 4 years; that accounted for 23% of the total number of animals in the troop. Sexually mature females in the years 1975–81 accounted for 40% of all the animals, but beginning from 1982 their number decreased to 31%. The dynamics of socionomic relations between the number of sexually mature females and males reflected

the character of changes in the troop. The rate of these changes was very intensive during the years 1978–81 when the first animals born in the Reserve attained pubertal age. Later, along with normalization of troop structure the dynamics of changes of socionomic relations in the troop decreased. By the year 1986 the structure of the First troop of Gumista reserve according to sex and age characteristics had been fully established, which actually was not different from the structure of the troop of hamadryas baboons in Errer-Gota, described by Kummer (1968).

The differential mortality of males and females and birth may be considered as a basis of demographic changes in the troop. The analysis of sex ratio of a total of 596 newborns in the First troop of the Reserve during the observational period revealed that 304 were males and 292 females; that corresponded to 1:0.96. Differences have been

TABLE 2. Age-specific mortality of free-ranging hamadryas baboons in 1974–1990.

Age	Number of females	Observed number of death	Females' mortality rate	Number of males	Observed number of death	Males' mortality rate
0–1 m.	243	76	0.312	237	66	0.278
1–6 m.	157	24	0.153	163	21	0.129
6–12 m.	144	6	0.042	146	3	0.020
1–2 y.	149	4	0.027	148	9	0.061
2–3 y.	148	5	0.034	136	5	0.037
3–4 y.	144	2	0.014	131	2	0.015
4–5 y.	141	0	0	124	2	0.016
5–6 y.	135	3	0.022	113	2	0.018
6–7 y.	129	6	0.047	103	1	0.010
7–8 y.	118	2	0.017	91	0	0
8–9 y.	99	1	0.010	72	1	0.014
9–10 y.	92	1	0.011	56	0	0
10–11 y.	87	3	0.034	37	0	0
11–12 y.	71	3	0.042	31	2	0.064
12–13 y.	62	0	0	24	0	0
13–14 y.	64	2	0.031	21	2	0.095
14–15 y.	50	2	0.040	16	1	0.062
15–16 y.	44	3	0.068	12	0	0
16–17 y.	34	4	0.118	8	0	0
17–18 y.	30	2	0.067	6	1	0.167
18–19 y.	19	4	0.210	2	0	0
19–20 y.	14	1	0.071	1	0	0
>20 y.	35	7	0.200	5	1	0.200

found between the indices of mortality of males and females. The higher mortality of females comparing with that of males was found during the first year of life of an infant (19.6% vs. 16.4%) and in all animals older than 4 years. Some higher mortality of males was characteristic for 1–4 years old juveniles (correspondingly 3.9% and 2.5%). No accidental character of the observed regularity is evidenced by the fact that in hamadryas baboons of Cone Rock some exceeding of infantile and juvenile female mortality comparing with the mortality of males has been registered on the background of a total high level of mortality. Besides, several other monkeys also show a relatively higher level of female mortality in comparison with that of males. In investigations of free ranging population of *Macaca sinica*, Dittus (1979) established that the mortality of female infants and juveniles is higher than that of males. However, the higher general mortality of females of hamadryas baboons during the first years of investigation can be explained taking into consideration the character of the structure of the group released. In that group adult and even old females accounted for the most number of animals, and correspondingly the rate of mortality in females was higher than in males.

It should be noted that, as a whole, the mortality and survival in the Reserve was characterized with age-related specificity (Table 2). The highest specific mortality occurred in newborns during the first month of life – 0.303, it was a little lower – 0.118 for the infants in the age of 1–6 months (age-specific mortality was calculated as in Sigg *et al.* 1982). The highest rate of survival (mean value – 0.990) was found in 4–10 year old monkeys. The rate of survival in baboons older than 15 years has been lowering to a value of 0.088 in the animals in the age of 15–20 years, and to a value of 0.170 in the animals older than 20 years. In all the age categories the mortality of monkeys in Gumista reserve is a little higher than in free ranging baboons in Ethiopia (Sigg *et al.* 1982).

The mean normal birth rate during the observation period was 0.59 for each sexually mature female. It was established that the variations in the percent of newborns in different years of observation are linked first of all with the part of effectively breeding 9–16 year old females in the total number of females in a troop. Besides, some correlation has been noted between the fertility of females and the total number of animals in a troop, which shows some decrease of female's fertility with increasing of the number of animals in the troop.

Forming of new harems

The group of hamadryas baboons released in the Gumista Reserve first looked as a formation of 2 big one-male units, dominated by 2 adult males. The two units included 17 and 16 mature females, respectively. Due to the lack of adult males in the group we observed the formation of first new one-male units only in 1978, when 2 of the oldest young males of the troop attained their sexual maturity. In total during the years 1978–1990 we observed the forming

of 27 new one-male units.

The observations have shown that the mean age of males and probability of forming of their own harem depended first of all on the complexity of social structure and the level of sexual competition in the troop. The occurrence and the intensification of such competition was associated with the appearance in the troop of cohort of 5–11 years old bachelors, which did not have females. The first of such bachelors appeared in the troop in 1980, and in 1986 their number increased up to 66.7% of sexually mature males of a troop. The mean age in which the males form their own harems increased from 6.5 in 1979–81 to 10.2 in 1986–90. The correlation established between mean age of harem forming by males and the percent of male bachelors among the mature males of the troop was $r=0.82$, $P<0.001$.

During all the years forming of new one-male units occurred according to two main mechanisms of new harem forming: 1) the new harems included the females which had been earlier the members of other male's harems, 2) it was based on the relationships between the young males and juvenile females. However, the contribution of these two sources of new stable link forming between the females and males in different years was various. During the first years of observation the forming of new units took place basing on decrease of the number of females mainly in the harems of two males-patriarchs. By 1982 when the number of females in the harems of the two patriarchs sharply decreased, this process stopped. Later on, the main mechanism of harem forming was establishment of stable relationships between the young males and juvenile females.

As it was shown during the observations, the relationships between the adult males and females, belonging to their harems, have been characterized with high stability and durability. The analysis of reproductive history of 25 females of the First troop, which were born in the Reserve and had attained the age of 15 years, has shown that adult females during most time of their reproductive period have transited from one unit to another as an average only once. Thirty six percent of females never left their first unit, 52% only once transited from one harem into the other, and 12% have been characterized with inconstancy – they changed the harem two or three times.

We assume that the hamadryas baboons' stability of male–female links has important consequences. As a result the probability of more stable relationships forming between the animals belonging to the same unit, comparing with those between the animals of a whole troop increases. The relationships between the young males – the offsprings of the same harem, underlay the process of forming of the next (according to its complexity) level of social organization – the clans.

Forming of clans

In our concept, the clan is a more or less stable formation which could be observed during their daily travels around

the territory of the Reserve. In our conditions the most suitable way of clan membership establishment was the registration of the order of monkeys' arrivals to a feeding place after giving a gong signal. It was suggested that the animals coming to a feeding place as a compact party could be considered as temporal subgroups, disjoining their group during their daily activity. The stability of such subgroups composition allowed to consider them as a clan. The observations have shown that hamadryas baboons' clans are the unions of the one-male units (from 3 to 7) together with bachelor males joined to them, which separate from the band during the daily activity. Belonging to a clan was evidenced by a relatively small distance between the males of one clan, and by higher frequency of aggressive support between the males belonging to the same clan. The first clan in the First troop of Gumista Reserve appeared in 1980, and by the year 1990 the troop included 4 clans. The analysis of clan composition and characteristics of the relationships between the animals belonging to a clan suggested that its formation took place mainly on the basis of the close relationships between the males. The core of each clan included the males – offsprings of the same one-male unit, first of all the related males. Particularly, one of the clans, which evidently existed in the troop for several years, included 3 pairs of brothers having not only a common father, but also a common mother.

Formation of bands

For studying the bands composition in the First troop of Gumista reserve, we used the band's criteria suggested by Kummer (1968), in particular – the independence of moving of definite subgroups and the aggressive character of relationships between them. During the first years after releasing the monkeys to a forest, all the animals of the group demonstrated a relative unity which was evidenced by sleeping at the same place and joint moving in the daytime. By 1980 some contradictions had been noted in the group which were expressed in an actual division of the group into two bands. Each band moved independently during the daytime, was relatively isolated in the places where they used to meet, and was characterized by a relatively high frequency of aggressive relationships between the males of different bands. Nevertheless, during the long observational period the monkeys of the two bands shared the same sleeping places. During most time of the year the animals slept in the beech trees on the edge of the beech forest. The distance between the trees in which the monkeys of different bands slept did not exceed 100 m, i.e. the animals could communicate via vocalization, and could have mutual support in the case of predators appearance. In winter after the snowfalls (the snow covered the ground for about 1 month) the baboons slept in special wooden houses not far from their sleeping places.

The origin of two bands of the First troop of the Reserve was associated with the development of two basic one-male units, occurring in the group in 1974. These bands forming was characterized with the situation in which the

young males – the sons of two patriarchs, while forming their own harems, had been keeping on their relatively tolerant and friendly interrelations with each other as well as with the members of their father's unit. So, two structures had been formed in which the members (first of all the males) were characterized with a relatively high mutual tolerance and friendliness. Simultaneously the contradictions between the males belonging to two coalitions increased. As a result of these contradictory tendencies two independent bands appeared which had completely developed by the end of 1980.

The group of hamadryas baboons as a self-organizing system

The survey of demographic changes and development of social structure of the group of free-ranging hamadryas baboons shows on the one hand the baboons' high adaptive plasticity, and on the other – conservativeness of these monkeys in their ability to selfproduction of their complex social structure. The artificially organized society, which represented a group of monkeys released in 1974, transformed in 5–6 years into a multilevel structure typical for this species. It is suggested that the observed phenomenon of successiveness of different levels of organization represents the whole character of relationships of various structural levels of hamadryas baboons' organization. This character is conditioned by stable relationships between the males and females of the same harem providing stability of the harem's composition, as well as by a predominant patrilocality, which is characteristic of hamadryas baboons. In these conditions the development of one-male units may lead to the forming of more complicated structural systems – clans and bands. Moreover, the increase in the number of band members, associated with the development of more complicated structure, may result in the band's transformation to independent troops. The two bands which we observed in 1992 were close to such a transformation. This was evidenced by the recently observed increased level of mutual aggression and intolerance between the animals of two bands.

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